

AP Biology, Semester 2
Unit Test: Circulation, the Body's Defenses, and Nutrition
Instructor Version

Section I: Multiple-Choice Questions

Answer Sheet

1.	E
2.	B
3.	C
4.	C
5.	B
6.	C
7.	B
8.	A
9.	A
10.	C

11.	D
12.	E
13.	D
14.	B
15.	C
16.	B
17.	E
18.	D
19.	A
20.	C

**Unit Test: Circulation, the Body's Defenses, and Nutrition
Instructor Version****Section II: Free-Response Questions**

Time Limit: You have 30 minutes to complete this section. Both questions are weighted equally, so allow around 15 minutes for each question. You may move back and forth between questions until time is called.

Scoring: 20 points each, 40 points total

Directions: Answer each of the questions in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement your answer, but a diagram alone is insufficient. Read each question carefully before you begin to write your answer.

- 1. The human heart is derived from a more primitive structure seen in simpler animals. Trace the changes from the simple heart of the earthworm to the four-chambered mammal heart.**

ANSWER:

As animals have grown larger and more complex, their organ systems have also had to increase in complexity to perform their functions. Earthworms have one of the simplest closed circulatory systems in which blood is pumped around the body: the dorsal vessel serves as a rudimentary heart, and five "auxiliary hearts" running between the dorsal and ventral vessels also aid the flow of blood.

Vertebrates have evolved a distinct muscular heart with valves to prevent the blood from being pumped in the wrong direction. All vertebrate hearts have at least two chambers—an atrium to receive incoming blood and act as a reservoir, and a ventricle to pump blood back out to the body.

As vertebrates colonized the land and placed new demands on the need for the blood to rapidly supply oxygen to the tissues for fast movement, the heart became ever more complex, evolving from the two-chambered heart of fish through the amphibian three-chambered heart to the four-chambered heart of birds and mammals.

- 2. The human body has several mechanisms to defend against infection.**

- A. Describe the mechanisms that keep infectious agents from entering the body.**

ANSWER:

External barriers keep infectious agents from entering our body. The skin, mucous membranes, and the substances they secrete are our external barriers. Sweat and oil secreted by the skin gives it a pH between 3 and 5, which is too acidic for most pathogens to survive. Saliva and tears wash away invaders. They also contain enzymes, for example lysozyme, that destroy pathogens. The mucous membranes secrete mucus, which traps invaders so they can be expelled or swallowed.

- B. When a pathogen does enter the body, describe how the body fights the infection.**

ANSWER:

The pathogen will first encounter the nonspecific immune defenses, which attack pathogens without targeting a specific invader. The cellular components of the nonspecific defenses are phagocytes, including neutrophils and macrophages, and natural killer cells. If the pathogens are microorganisms, like bacteria or fungi, phagocytes will ingest and destroy them. If the invader is a virus, natural killer

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cells attack the plasma membrane of the virus-infected cells, causing the cells to lyse.

The pathogens next encounter the specific immune defenses. When a pathogen enters the body, several things will happen. Macrophages, part of the nonspecific defenses, will ingest the pathogen and present the antigen on MHC-II molecules. If the pathogen is a virus, it will infect cells and viral particles will be presented on MHC-I molecules.

The antigen presented on an MHC-II molecule will activate helper T cells specific for the antigen. The antigen presented on an MHC-I molecule will activate cytotoxic T cells. The free pathogen will also activate B cells.

The activated lymphocytes will divide to produce memory cells and effector cells. The memory cells protect us the next time we encounter the antigen. The effector T cells will fight the infection and the effector B cells will secrete antibodies.

Activated cytotoxic T cells will secrete perforin causing the infected cell to lyse. Activated helper T cells will secrete cytokines to recruit other lymphocytes to fight the infection and to activate the complement system.

Antibodies secreted by the effector B cells bind to the pathogen. Since each antibody has two antigen binding sites, one antibody can bind to two pathogens. This creates a large clump of antibodies bound to pathogens. This large clump is identified and ingested by a macrophage.

Antibodies also activate the complement system—a group of proteins that destroy pathogens. The complement system is part of the nonspecific defenses, but it can also be activated by antibodies.